OVERVIEW

The Hot Mix Asphalt (HMA) Section, is responsible for the sampling, testing, inspection, recommendation for Acceptance (A) to administrating authority, Independent Assurance (IA) and Quality Assurance (QA) of Hot Mix Asphalt (HMA) mixtures, Performance Grade (PG) binders, asphalt cements, cutback asphalts, emulsions, and miscellaneous items; observing and/or performing sampling and testing of material used on construction, maintenance, municipal, and FAA projects, as well as implementation of specifications and associated new procedures for paving and paving-related items.

The Transportation Supervising Materials Testing Engineer (TSMTE) is the operational supervisor of the HMA Section and is assisted by a Transportation Materials Testing Engineer (TMTE). The TSMTE makes recommendations pertaining to the solution of problems regarding HMA mixtures and recommends research into the development of new and existing HMA processes and mixtures. The TSMTE initiates and directs the technical training of personnel in the techniques of sampling, inspection and testing of bituminous materials. The TSMTE prepares and keeps current the HMA section of the ***Materials Testing Manual***; initiates and aids in the development of revisions to specifications utilizing statistical concepts.

The TSMTE reports directly to the Transportation Assistant Director of Materials Testing (TADMT). The TSMTE is responsible to carry out policies and regulations as set forth by the Department of Transportation and maintain American Association of State Highway and Transportation Officials (AASHTO) Materials Reference Laboratory (AMRL) accreditation and testing proficiencies of AASHTO and American Society of Testing and Materials (ASTM) standards. The TSMTE, when requested, is responsible to conduct forensic studies on HMA material and pavements. The TSMTE prepares and supervises the preparation of technical reports and allied documents.

The TMTE is supervised by the TSMTE. The TMTE is responsible for overseeing the daily assignments of the field personnel and the testing activities of the HMA subsections. The TMTE assures the testing, inspection and compliance with testing requirements of contract documents. The TMTE is the supervisor for the Field Assurance & Radiation Safety Officer (RSO)/Nuclear density, Field HMA Plant Assurance, and the HMA technical Oversight sub-units. The TMTE confers with Offices of Construction and Maintenance representatives to help solve problems; has contact with HMA producers and contractors and coordinates necessary scheduling and testing, as required. The TMTE conducts periodic inspections of HMA plants and field operations.

The TMTE duties include contacting and preparing correspondences with materials producers, contractors, Department of Transportation and HMA Industry engineers concerning suitability of materials, materials acceptance, and their use. The TMTE is responsible for the inspection and approval of the HMA plant machinery and field laboratories; prepares and maintains production records, plant rankings, prioritize and assigning staff personnel for field inspections.

The Transportation Materials Technician 3s' (TMT3) of the HMA section are working supervisors who maintain testing expertise in HMA materials. The TMT3s are required to hold the applicable New England Transportation Technician Certification Program (NETTCP) certifications. The TMT3 are responsible to maintain a high level of technical expertise in HMA materials and field and Laboratory testing. The TMT3 participates in proficiency tests and on-site inspections conducted by the AMRL, to maintain laboratory accreditation required by Federal Highway Administration (FHWA.)

All sampling and testing of HMA materials is performed at the frequency and test protocols specified in the contract. If not specified, it is understood that the latest AASHTO and ASTM protocol available at time of contract bid governs when performing sampling and testing for acceptance. AASHTO and ASTM test protocol modifications are listed in appendix C.

5.01 PERFORMANCE GRADED (PG) ASPHALT BINDER

Scope: This section covers Performance Grade asphalt binders. PG binder suppliers shall comply with the annual "Requirements for Annual Submission of Quality Control Plan, AASHTO R-26 and as modified in Appendix C.

Sampling: In accordance with AASHTO T 40**(M)**: Sampling Bituminous Materials

Procedure: In accordance with the following standard methods of test:

1. AASHTO T 44: Solubility of Bituminous Materials
2. AASHTO T 48: Flash and Fire Points by Cleveland Open Cup
3. AASHTO T 228: Specific Gravity of Semi-Solid Bituminous Materials
4. AASHTO T 240: Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin Film Oven Test)
5. AASHTO T 313: Determining the Flexural Creep Stiffness of Asphalt Binder Using the Bending Beam Rheometer (BBR)
6. AASHTO T 314: Determining the Fracture Properties of Asphalt Binder in Direct Tension (DT)
7. AASHTO T 315: Determining the Rheological Properties of Asphalt Binder Using the Dynamic Shear Rheometer (DSR)
8. AASHTO T 316: Viscosity Determination of Asphalt Binder Using Rotational Viscometer (RT)
9. AASHTO R 28: Accelerated Aging of Asphalt Binder Using a Pressure Aging Vessel (PAV)
10. AASHTO R 29: Grading or Verifying the Performance grade of an Asphalt Binder

Specification: In accordance with AASHTO M 320, R-26 and contract specifications

Report: Form MAT 401

5.02 CUT-BACK ASPHALTS

Scope: These methods of test cover liquid petroleum products, produced by fluxing an asphaltic base with suitable light volatile solvents or distillates, to be used in the treatment of road surfaces.

Sampling: In accordance with AASHTO T 40**(M)**: Sampling Bituminous Materials

Procedure: In accordance with the following standard methods:

1. AASHTO T 79: Flash Point with Tag Open Cup Apparatus for Use with Material having a Flash Less than 200°F (93.3°C)
2. AASHTO T 201: Kinematic Viscosity of Asphalts
3. AASHTO T 227: Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
4. AASHTO T 78: Distillation of Cutback Asphaltic Products
   - 4.1 AASHTO T 49: Penetration of Bituminous Materials
   - 4.2 AASHTO T 202: Viscosity of Asphalts by Vacuum Capillary Viscometer

Specification: In accordance with AASHTO M 82 and contract specifications
Report: Results are reported on Form MAT-400

5.03 DAMPPROOFING

Scope: This section covers three asbestos-free asphalt roof coatings of brushing or spraying consistency suitable for use as waterproofing and damp proofing of concrete and concrete masonry.

Sampling: In accordance with AASHTO T 40**(M)**: Sampling Bituminous Materials

Procedure: In accordance with the following standard methods:

1. AASHTO T 49: Penetration of Bituminous Materials
2. ASTM D 95: Moisture, percent
3. ASTM D 4479: Nonvolatile Matter, percent
4. AASHTO T 72: Saybolt Viscosity
5. AASHTO T 78: Distillation of Cutback Asphaltic Products

Specification: In accordance with ASTM D 41 and ASTM D 4479, Type 1 Asbestos Free and contract specifications

Report: Results are reported on Form MAT 315

5.04 EMULSIFIED ASPHALT

Scope: These methods of test cover asphalt emulsions composed principally of a semisolid liquid asphaltic base, water, and an emulsifying agent. Sampling and testing for this item will be from Terminal and refinery sources of supply and from project tanker trucks when used as tack coat, emulsion for chip seal pavements, and specialty mixes.

Sampling: In accordance with AASHTO T 40**(M)**: Sampling Bituminous Materials

Procedure: In accordance with AASHTO T 59: Testing Emulsified Asphalt

Specification: In accordance with AASHTO M 140, M 208, and M 316 and contract specifications

Report: Results are reported on Form MAT 402

5.05 RECOVERY OF ASPHALT BINDER

Scope: This section covers the recovery of asphalt from a previously conducted extraction with reagent-grade trichloroethylene. The asphalt is recovered with properties substantially the same as those it possessed in the asphalt mixture and in quantity sufficient for testing. Sampling and testing for this item will be from newly mixed (virgin) HMA or materials that contain RAP; HMA stored in silos, from paver hoppers, pavement during lay down, and from roadway materials.

Sampling: In accordance with AASHTO T 40**(M)**: Sampling Bituminous Materials

Procedure: In accordance with the following standard methods:

1. AASHTO T 164 (M): Quantitative Extraction of Bitumen from Bituminous paving Mixtures
2. AASHTO T 170 (M): Recovery of Asphalt from Solution by Abson Method
    - 2.1 AASHTO T 202: Viscosity of Asphalts by Vacuum Capillary Viscometer
    - 2.2 AASHTO T 315: Determining the Rheological Properties of Asphalt Binder Using the Dynamic Shear Rheometer (DSR)
    - 2.3 AASHTO R 29: Grading or Verifying the Performance Grade of an Asphalt Binder

Specification: In accordance with AASHTO M 320 and contract specifications

Report: Results are reported on Form MAT 423

5.06 HOT POURED SEALERS FOR PC CONCRETE AND ASPHALT PAVEMENTS

Scope: This section covers joint sealants of the hot poured type intended for use in Portland cement concrete and asphalt concrete pavements.

Sampling: In accordance with AASHTO T 40**(M)**: Sampling Bituminous Materials

Procedure: In accordance with ASTM D 5329

Specification: In accordance with AASHTO M 324-Type 2 and contract specifications

Report: Form Mat 424

5.07 PIPE JOINT SEALER

Scope: This section covers cold applied bituminous sealer for reinforced concrete pipe.

Sampling: In accordance with AASHTO T 40**(M)**: Sampling Bituminous Materials

Procedure: In accordance with the following standard methods:

1. ASTM D 217: Cone penetration
2. ASTM D 6: Loss on Heating of Oil and Asphaltic Compounds
3. AASHTO T 44: Solubility of Bituminous Materials
4. AASHTO T 111: Inorganic Matter or Ash in Bituminous Materials

Specification: In accordance with contract specifications

Report: Form MAT 425

5.08 MEMBRANE WATERPROOFING

Scope: This section covers fully-adhered built-up bituminous membrane waterproofing system for bridge decks.

Sampling: In accordance with AASHTO T 40**(M)**: Sampling Bituminous Materials

Procedure: In accordance with the following standard methods:

1. Primer: ASTM D 41:
2. Asphalt: ASTM D 449, Type II:
3. Fabric: ASTM D 1668:
4. Bituminous Plastic Cement: ASTM D 2822, Type I:

Specification: In accordance with ASTM C 981 and contract specifications

Report: Form MAT 315

5.09 ASPHALTIC PLUG JOINT

Scope: This section covers the components, testing, and application requirements for field molded asphaltic plug material used within expansion joints on bridges with asphalt concrete overlays or PC concrete decks.

Sampling: In accordance with AASHTO T 40**(M)**

Procedure: In accordance with ASTM D 6297 Table 1 and special provision specifications

1. Thermoplastic Polymeric-modified asphalt binder per manufacturer specifications
2. Aggregate per manufacturer specifications
3. Foam expansion joint filler per manufacturer specifications
4. Steel bridge plate per manufacturer specifications

Specification: In accordance with ASTM D 6297 and contract specifications

Report: Results are reported on Form MAT 315

5.10 QUANTITATIVE EXTRACTION OF BINDER FROM HMA

Scope: This method of test is intended for the determination of the percentage of bitumen in a paving mixture. It is not intended for use in recovering the bitumen for further testing. The aggregate and mineral matter recovered from this test is used for sieve analysis.

Sampling: In accordance with AASHTO T 168 (M): Sampling Bituminous Paving Mixtures

Procedure: In accordance with AASHTO T 164 Method A **(M)**. The ash correction is determined by Article 11.6.1

Specification: In accordance with contract specifications

Report: Asphalt results are reported on Form MAT 412, MAT 412S or MAT 413. Ash results are reported on Form MAT 422.

5.10.1 BINDER CONTENT BY IGNITION METHOD FOR HMA

Scope: This method of test is intended for the determination of the total percentage of bitumen in HMA mixtures. Aggregate calibration for each class of mixture shall be provided by the DRM or may be submitted by the contractor for use during production.

Sampling: In accordance with AASHTO T 168 (M): Sampling Bituminous Paving Mixtures

Procedure: In accordance with AASHTO T 308(M)

Specification: In accordance with contract specifications

Report: Results are reported on Form MAT 412, MAT 412S or MAT 413

5.11 MECHANICAL ANALYSIS OF EXTRACTED AGGREGATE

Scope: This method of test covers a procedure for the determination of the particle size distribution of fine and coarse aggregates extracted from HMA mixtures using sieves with square openings.

Sampling: In accordance with AASHTO T 168 (M): Sampling Bituminous Paving Mixtures

Procedure: In accordance with AASHTO T 30(M)

Specification: In accordance with contract specifications

Report: Results are reported on Form MAT 412, MAT 412S or MAT 413

5.12 RESISTANCE TO PLASTIC FLOW OF HOT MIX ASPHALT MIXTURES

Scope: This method of test determines of the stability and flow of Hot Mix Asphalt paving mixtures using Marshall Mold Specimens

Sampling: In accordance with AASHTO T 168 (M): Sampling Bituminous Paving Mixtures

Procedure: In accordance with AASHTO T 245: Resistance to Plastic Flow of Bituminous Mixture Using Marshall Apparatus

Specification: In accordance with contract specifications

Report: Results are reported on Form MAT 412

5.13 BULK SPECIFIC GRAVITY OF COMPACTED HMA MIXTURES

Scope: This method determines of the bulk specific gravity of compacted HMA mixtures.

Sampling: In accordance with AASHTO T 168 (M): Sampling Bituminous Paving Mixtures.

Procedure: In accordance with AASHTO T 166 (M): Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated-Surface Dry Specimens

Specification: In accordance with contract specifications

Report: Results are reported on Form MAT 412 or Form MAT 412S

5.14 MAXIMUM SPECIFIC GRAVITY OF HMA PAVING MIXTURES

Scope: This method of test covers the determination of the maximum specific gravity of uncompacted HMA paving mixtures.

Sampling: In accordance with AASHTO T 168 (M): Sampling Bituminous Paving Mixtures

Procedure: In accordance with AASHTO T 209 (M): Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures

Specification: In accordance with contract specifications

Report: Results are reported on Form MAT 412 or Form MAT 412S

5.15 SAMPLING HMA PAVING MIXTURES

Scope: These methods of test cover the procedures for sampling mixtures of HMA material with mineral aggregate as prepared for use in paving.

Sampling: In accordance with AASHTO T 168 (M): Sampling Bituminous Paving Mixtures

Procedure: In accordance with AASHTO M 323: Superpave Volumetric Design Method.

When sampling and testing is required by a NETTCP certified HMA QC contractor, the contractor technician, or their representative shall arrive a minimum of one hour in advance of any production to test component moisture and gradation properties, turn on and preheat laboratory equipment, and prepare PC and test forms.

Specification: In accordance with contract specifications

Report: Results are reported on Form MAT 412 or Form MAT 412S

5.16 PREPARATION OF MARSHALL MOLD SPECIMENS

Scope: These methods cover the preparation of test specimens using Marshall Apparatus in conformance with procedures specified in AASHTO R-12.

Sampling: In accordance with AASHTO T 168 (M)

Procedure: In accordance with AASHTO T 245 (M)

Specification: In accordance with contract specifications

Report: Results are reported on Form MAT 412

5.16.1 PREPARATION OF GYRATORY SPECIMENS

Scope: These methods cover the preparation of test specimens using the gyratory compactor. Each apparatus shall be calibrated, maintained and serviced in accordance with the specifications and the manufacturer's recommendations.

Sampling: In accordance with AASHTO T-40(M).

Procedure: AASHTO M 323: Superpave Volumetric Mix Design
AASHTO R 35: Superpave Volumetric Design for Hot Mix Asphalt
AASHTO T 329: Moisture Content of Hot Mix Asphalt by Oven Method

HMA materials sampled for the purpose of determining physical, volumetric, and other properties shall not be heated beyond 1 hour from the time of sampling from a delivery truck. Physical, Volumetric and other properties shall be calculated in accordance with the contract specifications and AASHTO M 323 and R 35. In addition, the following analysis will be employed by the DRM to evaluate the results of individual production test data:

VMA_m (Voids in Mineral Aggregate from the mix):
VMA_a (Voids in Mineral Aggregate from Va & Vbe):

1. VMA calculated from the mix shall be determined in accordance with *Formula 5.16.1(i) or (ii)*. It can be correlated that the VMA calculated from AASHTO R-35 is equivalent to VMA_m or VMA_a when the Pb_a is known and substituted for A_{cf}, as shown in *Formula 5.16.1(i) or (ii*. Test results from VMA_m or VMA_a shall therefore be required to meet all contract specifications. Values of VMA_m or VMA_a that are out of specifications during production may be cause for the contractor to determine assignable cause, take corrective action, and modify the JMF, as needed. Continued VMA_m data that is out of specifications may be cause for the DRM to order cessation of supply.

    a. *Formula 5.16.1A*. Determining the VMA of HMA by the mix or air voids & effective binder method:

i. $$VMA_m = 100 - \left[\frac{Gmb_d \times (100 - Pb_t)}{Gse}\right] - \left[\frac{A_{cf} \times Gmb_d}{G_b}\right]$$ *or*

ii. $$VMA_a = V_a + \left[\frac{(Gmb_d \times (Pb_t - A_{cf})}{G_b}\right]$$

where: VMA_m *= VMA calculated from plant production mix*
Gmb_d *= Bulk specific gravity as determined by AASHTO T 166*
Pb_t *= Binder Total content (corrected) by AASHTO T 308*

A_{cf} = Absorption correction factor provided by Contractor (refer to b. i thru iii)
Gse = Effective Specific gravity determined by AASHTO M 323

b. *Formula 5.16.1B*. Determining the HMA mix binder correction factor for each class by use of Percent absorption of water by AASHTO T-84/85, AASHTO T-315 and D_f method. This value shall be performed by the Contractor during the mix design and submitted as a JMF value. Three methods for determining the Acf are shown, although method (i) will be the desired method to be used. All three methods are equivalent when the Gsa, Gsb and Pwa are recent and valid for the mix. Since method (iii) is an estimate based on trap rock based mixtures, some allowance and calibration may be needed for mixes that are composed with granite, gravel, or other aggregate materials but the change is estimated to be minimal (± 0.1 or less)

i. $A_{cf} = Df \times Pwa$

ii. $A_{cf} = Pba$

iii. $A_{cf} = x1 \ldots x6$

where: *Df = as determined by Formula 5.16.1C.*
Pwa = as determined by AASHTO T-84/85
Pba = as determined by AASHTO M 323

X1 = 0.3 for class 37.5 mm
X2 = 0.4 for class 25.0 mm
X3 = 0.5 for class 19.5 mm
X4 = 0.6 for class 12.5 mm
X5 = 0.7 for class 9.5 mm
X6 = 0.8 for class 4.75 mm

2. D_f (Density Factor): The Contractor shall calculate the HMA mix design D_f (*derived from formula #18 from A.1.2 of AASHTO R 35)* for each class of material, in accordance with *Formula 5.16.1C*. Test results of the D_f from each test shall be between 0.4 and 1.0. Values of D_f that are not within 0.4 and 1.0 shall be sufficient cause by the DRM for the specific gravity values of Gsa and Gsb to be suspect. The Contractor shall determine assignable cause(s) and take corrective action. Continued production data that is out of specifications may be cause for the DRM to order cessation of supply.

a. *Formula 5.16.1C*. Determining the Density Factor *(D_f)* of production HMA:

i. $$D_f = \left(\frac{Gse - Gsb}{Gsa - Gsb} \right)$$

where: *Df = Density Factor determined by AASHTO R-35*
Gse = Effective Specific gravity determined by AASHTO M-323 at plant
Gsa = Apparent Specific gravity determined by AASHTO T-84/85 of mix design
Gsb = Bulk specific gravity determined by AASHTO T-84/85 of mix design

Specifications: In accordance with contract specifications
Report: Results are reported on FORM 412, MAT 413, and MAT 412S

5.16.2 VOLUMETRIC AND SPECIFC GRAVITY CALCULATIONS FOR SUPERPAVE HMA.

Scope - These methods cover the determination of volumetric and specific gravity calculations of test specimens made by Superpave gyratory compactor.

Sampling: In accordance with AASHTO T 40(M)

Procedure: In accordance with AASHTO M 323

Specifications: In accordance with contract specifications

Report: Results are reported on FORM MAT 412, MAT 413, and MAT 412S

5.17 PRODUCTION INSPECTION AT HOT MIX ASPHALT PLANTS

Scope: The purpose of production inspection is not only to check on the operations for compliance to the specifications, but also to insure the best possible quality product with the available materials and equipment. The primary goal during production is to maintain a certain degree of uniformity not only daily but also throughout the life of the contract. The aggregate in each stockpile must be of uniform quality and gradation; the materials must be fed into the plant in a uniform, controlled manner; the heating and drying of the aggregates must be uniform; the separation of the aggregates into their various bin sizes must be uniformly controlled; and the aggregates and the asphalt cement must be combined and mixed in a uniform, consistent manner.

For these reasons, the inspector must be thoroughly familiar with all phases of the manufacturing process, be a well-qualified and conscientious inspector by being alert, knowledgeable, and persuasive.

Sampling: In accordance with section 5.15 and 5.18 as stated herein.

Procedure: In accordance with contract specifications and Form MAT 430

Production inspection at the HMA plant is divided into four main categories:

1. **Process Control (PC):** *Typically performed by the HMA producer prior to production and shipment*
2. **Quality Control (QC):** *Typically performed by the HMA producer during production*
3. **Acceptance (A):** *Typically performed by the State Highway Agency (SHA) or their representative*
4. **Verification (V):** *Typically used by the State Highway Agency (SHA) when the QC test results are used to determine material acceptance and payment. SHA may use split and independent (V) samples to validate QC test data.*
5. **Independent Assurance (IA):** *Typically performed by a separate SHA unit to ensure conformity of testing proficiency, personnel and equipment consistency*

Specification: In accordance with contract specifications

Report: Results are reported on FORM 412, MAT 413, and MAT 412S

5.18 DUTIES OF THE HMA PLANT INSPECTOR

Scope: The inspection will consist of checking the quality of materials in the stockpile, cold bins, and hot bins when required; inspection of processing, sampling; and testing the finished product for conformance to the specifications. The duties listed here are sample requirements to be performed by all types of Inspectors (i.e., PC, QC, (A), and IA). The responsibilities of a HMA inspector will include but are not limited to that shown in Form MAT 431.

Sampling: In accordance with contract specification

Procedure: In accordance with contract specifications and Form MAT 432

Specifications: In accordance with contract specification

Report: Results are reported on FORM MAT 412, MAT 413, MAT 412S and Daily Inspector Report \ Form MAT 431

5.19 DEGREE OF PARTICLE COATING OF HMA MIXTURES

Scope - This test is intended to determine the degree of coating of coarse particles of aggregate in a HMA mixture in relation to the wet mixing time. When HMA is mixed coarse particles of aggregate are the last and the most difficult to coat, and the degree of their coating may be a measure of the degree of mixing.

Sampling: In accordance with AASHTO T 195 (Modified) and T 168

Procedure: In accordance with AASHTO T 195

Specification: In accordance with contract specifications

Report: Results are reported on Form MAT 412 or MAT 412S

5.20 ANNUAL QUALIFICATION OF HOT MIX ASPHALT PLANTS

Scope: This section covers requirements for qualifying facilities for the production of hot-mixed asphalt paving mixtures for use on Department projects annually or more frequently, as needed. Materials, technicians, mix designs, and calibration and test records shall be as required in the contract specifications. The DRM reserves the right to perform random spot inspections to any of the above items during the productions season to ensure compliance to all specifications.

Sampling: Sampling of materials and equipment will be done during site inspection by Department personnel.

Procedure: Hot Mix Asphalt plants are inspected annually during the spring season in accordance with Form MAT 404 for Batch plants and Form MAT 405 for Drum Plants.

Specifications - Approval criteria for HMA Plants shall comply with AASHTO M 156(M) for a Batch Plant or a Drum Dryer Mixer Plant and contract specifications.

Report: Form 404 for Batch Plants and Form 405 for Drum plants

5.20.1 - HMA Plant Field Testing Laboratory

Scope: The requirements for the HMA Plant field Testing Laboratory will be in accordance with Form 406 and Contract specifications. The Contractor shall furnish a field laboratory approved by the DRM prior to any production. The contractor shall maintain all required testing equipment, laboratory items and needed calibration records up to date and make the field laboratory available for DRM use.

Procedure - An acceptable laboratory shall be in compliance with Forms MAT 406 and contract specifications.

Specification: In accordance with contract specifications

Report: Results of inspection shall be reported on:

1. FORM MAT-404 - Check List for HMA Plants (batch type)
2. FORM MAT-405 - Check List for HMA plants (drum type)
3. FORM MAT-406 - Field Laboratory Apparatus Inspection Sheet
4. FORM MAT-407 – Deficiency Form
5. FORM MAT-415 – HMA guideline for sampling platform stand

5.21 HOT MIX ASPHALT PRODUCTION - REQUEST FOR TEST

Scope - Production and placement of Hot Mix Asphalt is unique in that mixtures must be tested during manufacture and placement and both are weather dependent. Consequently, testing personnel may be notified of upcoming paving operations with as little as 12 hours notice. It is imperative that project personnel provide notification to the Division of Materials Testing as soon as possible. Forms MAT 420 (district construction) and MAT 421 (maintenance) are guidelines for project personnel regarding HMA testing. The Division of Materials Testing typically sends these forms to projects in March of each year.

Sampling – N/A

Procedure – Site Manager Procedures Manual

Specifications – In accordance with contract specifications

Report – MAT 100

5.22 HMA INSPECTION PERSONNEL ASSIGNMENT PROCEDURE

Scope - A priority system is utilized in assigning Hot Mix Asphalt plant inspectors, employing a review of computer-generated records of past plant performance, as well as firsthand knowledge of plant performance and current testing results. This priority system is developed by analyzing all test data on a daily basis, and rating the plants according to past performance data. The ability of a bituminous plant to produce a consistent, uniform product entitles that plant to an "A" for Acceptance rating. A plant that produces an inconsistent, non-uniform product will receive a "PT" for Production Trial rating. This rating is updated daily. (A) classes may be produced without delay while PT classes will generally receive more oversight. This information assists in prioritizing daily assignment of HMA inspectors to bituminous plants based on the following:

1. **Poor recent performance** – determined by tabulating the latest 10 test average for each class where the running average is below 70%

2. **Daily tonnage produced** - where larger tonnage will generally get higher priority

3. **Random sampling** – as determined by the DRM

Sampling: N/A

Procedure: N/A

Specifications: N/A

Report - N/A

5.22.1 HMA STATUS FOR NEW MIXES, CESSATION OF SUPPLY OR JMF CHANGES

Scope: Each Plant will have each class of HMA material evaluated daily based on the last 10 test average for the purpose of establishing a ranking for that class. Based on the ranking a class receives will determine whether the material can be shipped un-interrupted, the plant ceases supply or received a disincentive, as required by the specifications. Rankings will be provided to each HMA producer annually at the beginning of the paving season or more frequently as applicable.

Sampling: In accordance with contract specification

Procedure: Rankings for each class are as follows:

1. "A" – Approved ranking: Given to a material class from a producer with a current ranking of 70% or better based on specification compliance for gradation, binder content (Pb), Air

Voids (Va), Voids in Mineral Aggregate (VMA), Maximum Theoretical Gravity (Gmm), Effective Specific Gravity (Gse), Percent Density at Initial gyrations (P_{Ni}), and Percent Density at maximum gyrations (P_{Nm}). Ranking is the average of the 10-test running average for that class of material. For a test to be deemed acceptable, every single item of the above 8 criteria must meet specifications for each test. An "A" will also be given to a supplier after successfully completing a PT test on that material. Materials ranking an "A" will be permitted to be shipped to Department projects with no interruption provided that they continue to meet all specifications.

2. "PT" – Production Trial ranking: Given to a class of material from a producer with a current ranking of 69% or less based on specification compliance for gradation, Pb, Va, VMA, Gmm, Gse, P_{Ni}, and P_{Nm}. Ranking is the average of the 10-test running average for that class of material. A "PT" is also the first test status after a successful "PPT" is obtained. Materials ranking an "PT" will be permitted to be shipped to Department projects with no interruption provided they continue to meet all specifications but will be subject to more inspection, IA testing and oversight by Department inspection personnel.

3. "PPT" – Pre-Production Trial ranking: Given to a class of material from a producer with no prior production history or has a change in one or more component aggregate from the JMF on record with the DRM. "PPT" status will also be given to a class that:

    i. from an "A" ranking, has been ordered to "cease production" due to two consecutive tests not meeting specifications for gradation or Pb specification in a single day, or
    ii. from a "PT" ranking, has been ordered to "cease production" due to one single test not meeting specifications for gradation or Pb specification in a single day, or
    iii. has four consecutive tests not meeting Va, VMA, Gmm, Gse, P_{Ni}, or P_{Nm} for multiple days of production.

    HMA materials ranked with a "PPT" shall not be permitted to be shipped to CTDOT projects. PPT testing shall be performed on that class of material by the HMA producer and meet all specifications before production shipment may be resumed. At no time shall material ranked PPT be shipped to CTDOT projects.

    Contractors that have mix classes ranked a PPT may use one of the following methods to change the ranking:
    1. Schedule a day when the DRM can be at the HMA facility to witness a passing test or,
    2. Notify the DRM that a trial will be conducted by the Contractor or their representative, perform needed testing and submit the passing test results along with (minimum masses required by AASHTO) 2 gyratories, +2500 grams of boxed HMA for binder and gradation determination and +2,500 grams of cooled, loose HMA for Gmm determination.

JMF changes for gradation, Pb, Gmm, and Gse will be approved by the DRM subject to the following requirements. JMF changes are permitted on HMA materials provided that:

1. they are requested and pre-approved by the DRM,
2. changes do not exceed 50% of the tolerances for that item,
3. they are based on a two test trend,
4. they are documented with a promptly submitted revised JMF,
5. request for JMF changes are received to the DRM prior to the second test of the day for Superpave materials,
6. request for JMF changes are received to the DRM prior to the third test for Marshall materials, and
7. request for JMF changes are received to the DRM prior to any production for either Marshall or Superpave materials.

Repeated JMF requests for a mix or JMF requests to avoid a monetary disincentive or cessation of supply will be denied and HMA materials subject to applicable cessation and/or monetary disincentives or rejection.

JMF changes to the component or mix Gsa, Gsb, Pwa, or aggregate consensus properties will only be approved with proper documentation that the test results were obtained and performed by an AMRL accredited Laboratory and be submitted with proper detailed and summary documentation to the DRM for approval. JMF changes for these items will only become effective the next production day after the DRM has reviewed and accepted the JMF request for change. There will be no retroactive determinations made.

A class of mix is subject to "cessation of supply" when the production testing in not in conformance with the specifications, rankings fall below a PT, as stated herein and in the specifications, or it has been determined by the DRM that the production facility, the field laboratory, testing personnel or materials are in non-compliance with the specifications.

"Cessation of supply" status may be cause for a monetary disincentive and/or PPT trials as follows:

1. Monetary Disincentive and PPT trials for Superpave materials:
    a. When two consecutive tests from a batch, drum, or silo do not meet specifications for gradation or Pb for a mix with an "A" ranking in a single day, or
    b. When a single test from a from a batch, drum, or silo does not meet specifications for gradation or Pb for a mix with a "PT" ranking in a single day.

2. Monetary Disincentive and PPT trials for Marshall materials:
    a. When two consecutive tests from a batch, drum, or silo do not meet master range specifications for gradation or Pb for a mix in a single day, or
    b. When three consecutive tests from a batch, drum, or silo do not meet JMF specifications for gradation or Pb for a mix in a single day, or

3. Cessation and PPT trials only (no monetary disincentive) for Superpave mixtures:
    a. batch or drum plant: when four consecutive tests do not meet specifications for volumetrics (Va, VMA, Gmm, Gse, P_{Ni}, and P_{Nm}), for a mix with an "A" ranking regardless when taken, or
    b. batch or drum plant: when two consecutive tests do not meet specifications for volumetrics, for a mix with a "PT" ranking regardless when taken, or
    c. Silo: when two consecutive tests do not meet specifications for volumetrics, regardless when taken, or
    d. Silo: when a single test does not meet specifications for gradation or Pb, or
    e. Batch, drum plant, or Silo: when a single PT test fails volumetrics, or
    f. Batch, drum plant, or Silo: when a single test value for Gse is greater than the JMF Gsa or less than the JMF Gsb for that class.

Specifications: In accordance with contract specification

Report:

1. HMA Plant rankings will be supplied in the spring of each construction season and upon request thereafter on Form MAT 428 or MAT 428S and MAT 432
2. JMF (original and revisions) forms shall be submitted by the Contractor on Form MAT 429S along with detailed mix design test data as required by AASHTO M 323

5.23 GUIDELINES FOR HMA MIXES AND THEIR APPLICATION

Scope: A guideline for the proper use and thickness of Marshall and Superpave mixtures is available by the DRM upon request. It lists recommendations for selection of class(es), milling and other useful information.

5.24 IN-PLACE DENSITY TESTING OF HMA

Scope: This procedure covers the determination of the in-place density of HMA by using an approved Nuclear Density (ND) Gauge. This procedure is used as an in-situ method to ensure that HMA pavement density requirements are met for acceptance and payment purposes. These density requirements shall be applied to all construction and resurfacing projects where the compacted depth is specified to be a minimum of 1-1/2 in. or greater. This procedure shall establish the calibration of the gauge, density testing of the material and calculation of the test results for acceptance and payment.

Procedure: Field testing of pavement density shall be performed as stated herein and in accordance with ASTM D 2950 (M). The density results obtained by this method shall be reported as a percent of the maximum theoretical gravity (Gmm) performed in accordance with AASHTO T 209 (M) and shall be based on the 10-test running average or the average of all tests when less than 10, from the source of supply for that class.

Calibration: All ND gauges shall be calibrated as directed by the Director of Research and Materials (DRM) each year prior to the start of the construction season or prior to initial use on Department projects. Calibration blocks shall be provided by the Department or the gauge manufacturer. Alternate calibration blocks shall be approved by the DRM. The ND gauge shall be calibrated in accordance with manufacturers' recommendations and by determining the count rate and density on approved calibration blocks. The ND gauge calibration procedure is as follows:

A. Each reading will be a minimum of 4 minutes in duration.
B. Four (4) incremental readings will be taken with gauge sitting on calibration block and averaged.
C. Final test results of the ND on the calibration block will be within + 1.0 pcf of the 164.5 pcf calibration block provided by the Department whether the source is positioned in the thick-lift or thin-lift position.
D. The accuracy correlation (bias) will be determined as the difference from the known block density to the final calculated value as determined above.
E. A bias value will be chosen to adjust the pcf result so the ND gauge meets the accuracy requirements stated in (C). If a ND gauge can not meet the accuracy requirements as stated herein and in ASTM D-2950(M): Appendix A, the ND gauge shall be repaired by its owner and/or the manufacturer and calibrated prior to its use.
F. This bias will be utilized by the ND gauge owner and recorded on test reports for all occasions when the ND gauge is utilized on HMA materials until a new value is established.
G. The DRM reserves the right to require new calibration of a ND when there is evidence to suggest the source or the device is inaccurate.

Standardization: As a minimum, standardization of the ND gauge shall be performed daily prior to its use. This process shall be performed in accordance with ASTM D-2950(M): Section 8, as described in the manufacturer's guidelines and as directed herein.

A. Each day's standard count reading shall be recorded. If the subject value is within 2 standard deviations of the target value established during the time of calibration, the gauge will be accepted for use.
B. If the standard count does not fall within the required 2 standard deviations of the target value established during the time of calibration, additional standard counts may be run. If successive standard counts are not in compliance as stated above, the gauge cannot be used and must be re-calibrated.

Test location selection: After the proper lots and sub-lots for testing are determined, in accordance with Article 4.06.04-1 D-1, the following methods shall be used.

A. All distance measurements shall be taken by measurement device (measuring wheel) or reference stationing on the project.
B. Longitudinal and transverse test site selection shall be established utilizing stratified random sampling in accordance with ASTM D 3665.
C. Transverse locations for the test site shall be measured from the edge of paver pass.
D. If the random number selected locates a transverse offset less than 1 ft. (0.3m) from either edge, relocate the gauge 1 ft. (0.3m) from that edge.
E. For longitudinal joint testing, determined the test location within each sub-lot by use of random numbers. Longitudinal joint offset calculations are not required.
F. Large vertical masses such as Jersey Barriers can affect the reading of a nuclear gauge. Therefore, when a random number locates the ND gauge less than 1 ft. (0.3m) from any vertical mass, relocate the gauge 1 ft. (0.3m) from that vertical mass.

Testing Non-Bridge and Bridge HMA pavements: The operation of the ND gauge for testing pavements shall be as follows:

A. For all test locations, two 30-second measurements (readings) will be taken in the direction of paving at 180 degree angles to each other (rotated around the center of the gauge). The density value reported for each test location will be the average of the two measurements.
B. For thick-lift HMA overlays of 2 ½ in. or greater in depth, testing shall be performed using the testing position recommended by the manufacturer such that approximately 90 percent of a single reading will be affected by the top 3 to 4 in. of material.
C. For thin-lift HMA overlays 1 ½ to 2 ½ in., the testing shall be performed using the testing position recommended by the manufacturer such that approximately 90 percent of a single reading will be affected by the top 2 in. of material

Testing HMA Longitudinal Joints of Non-Bridge and Bridge HMA pavements (Hot side only):

D. When successive adjacent (two or more) passes are made by the paver, proper lots and sub-lots for testing will be determined, in accordance with Article 4.06.04-1 D-1. The following methods shall be used to test the total length of the longitudinal joint(s):
E. The edge of the gauge shall be placed parallel along the “hot side” of longitudinal joint, which locates the gauge source rod approximately 6-in. from the joint.

5.24.1 Dispute Resolution request by Contractor for HMA density:

Scope: When it is determined by the DRM that production does not meet the minimum density requirements by ND gage and the material is subject to a monetary disincentive (roadway or bridge for mat or joint), the Contractor may elect to invoke a dispute resolution within the following procedure.

Procedure: as follows:

A. The Contractor shall request, in writing that cores be taken by the Contractor and witnessed by the DRM in the area represented by the non-compliant date of production to the District administrating the contract for approval.
B. Five cores (6 inch diameter-wet sawed) will be taken by the Contractor from stratified random locations selected by the DRM, in accordance with ASTM D 3665, to represent the material in question.
C. Five cores (6 inch diameter-wet sawed) will be taken by the Contractor from stratified random locations selected by the DRM to represent the longitudinal joint (hot side only) of the material in question.
D. Cores shall be labeled with number, location, date and stored in a safe manner to ensure no damage occurs *(i.e., core 1M for first mat core; core 1J for first joint core, etc.)*
E. The cores will be tested in accordance with AASHTO TP 69 (Corelok method) by the DRM.
F. The basis of adjusted payment will be determined by comparing the average of the 5 core densities to the specifications.

G. All core data will be used for the determination of density except that individual cores that are damaged or obviously defective will be replaced with new cores from the same sub lot.
H. Core holes shall be repaired immediately upon core extraction by decanting any free water, tack coating cut surface, filling with hot mixture of same class, and compacting with hand compactor or other mechanical means to the maximum compaction possible. The final core hole surface shall be with +1/8 inch of the finished pavement prior to opening to traffic.
I. Traffic control, coring equipment, personnel, core hole repairs and HMA materials shall be provided by the Contractor at no expense to the Department.
J. Laboratory testing of all cores will be performed by the DRM at no expense to the Contractor. Payment will be based on the average density obtained from the cores.

Specifications: In accordance with contract specifications

Report: Form CON 133, or on a form approved by the Director of Research and Materials.

5.25 DENSITY OF SOIL AND SOIL-AGGREGATE BY NUCLEAR METHODS

Scope: This procedure covers the determination of the in-place density of soil and soil aggregate by using an approved Nuclear Density (ND) Gauge. The procedure is used as an in-situ method to ensure that the soil density requirements are met for acceptance and payment purposes. These density requirements shall be applied to all construction and resurfacing projects where the compacted depth is specified to be a minimum of 1-1/2 in. or greater. This procedure shall establish the calibration of the gauge, testing of the material and calculation of the test results.

Procedure: Field testing shall be as stated herein and in accordance with AASHTO T 310 (M). The density results obtained by this method shall be reported as a percent of the maximum proctor value performed in accordance with AASHTO T 180 (M), sampled from the approved source. At the conclusion of each day's production, the final density average shall be calculated.

Calibration: All ND gauges shall be calibrated by the Engineer each year prior to the start of the construction season or prior to initial use on Department projects. Calibration blocks shall be provided by the Department or the gauge manufacturer. Alternate calibration blocks shall be approved by the DRM. The ND gauge shall be calibrated in accordance with manufacturers' recommendations and by determining the count rate and density on approved calibration blocks. The range of densities of the calibration blocks shall be similar to the expected pavement densities that will be encountered in the field. The ND gauge calibration procedure is as follows:
a. Each reading shall be a minimum of 4 minutes in duration.
b. Four (4) incremental readings will be taken with gauge sitting on calibration block and averaged.
c. Final test results of the ND on the calibration block shall be within + 1.0 pcf of the 131.5 pcf calibration block provided by the Department whether the source is positioned in the thick-lift or direct transmission position.
d. The accuracy correlation (bias) will be determined as the difference from the known block density to the final calculated value as determined above. A bias value will be chosen to adjust the pcf result so the ND gauge meets the accuracy requirements. If a ND gauge can not meet the accuracy requirements as stated herein, the ND gauge shall be repaired by its owner and/or the manufacturer and calibrated prior to its use. This bias will be utilized by the ND gauge owner and recorded on test reports for all occasions when the ND gauge is utilized on HMA materials until a new value is established.
e. The Engineer reserves the right to require new calibration of a ND when there is evidence to suggest the source or the device is inaccurate.

Standardization: As a minimum, standardization of the ND gauge shall be performed daily prior to its use. This process shall be performed in accordance with AASHTO T- 310, as described in the manufacturer's guidelines and as directed herein.
a. Each day's standard count reading shall be recorded. If the subject value is within 2 standard deviations of the target value established during the time of calibration, the gauge will be accepted for use.

b. If the standard count does not fall within the required 2 standard deviations of the target value established during the time of calibration, additional standard counts may be run. If successive standard counts are not in compliance as stated above, the gauge cannot be used and must be re-calibrated.

Test location selection: After the proper lots and sub-lots for testing are determined, in accordance with the Department Standard Specification Article 4.06.04-1 D-1, the following methods shall be used. All distance measurements shall be taken by measurement device or reference stationing on the project.

a. Field test site selection shall be established utilizing stratified random sampling in accordance with ASTM D 3665, or

b. Select a repetitive feature located within the testing area, such as utility poles or job stationing, to establish a suitable marker. Determine the number of markers present and divide by the number of tests to be performed, so that the lot is divided equally into the predetermined number of sub-lots *(for example: if the lot contains 30 utility poles in the test area and 10 tests are to be taken, each sub-lot will be located longitudinally within each 3 utility poles when measured from beginning edge of the days' pavement.)*

c. For soil testing, determine the longitudinal and transverse test location within each sub-lot by use of random numbers. If the random number selected locates a transverse offset less than 1 ft. (0.3m) from a limit of the material, relocate the gauge 1 ft. (0.3m) from that location

d. Large vertical masses such as Jersey Barriers and abutments can affect the reading of a nuclear gauge. Therefore, when a random number locates the ND gauge less than 1 ft. (0.3m) from any vertical mass, relocate the gauge 1 ft. (0.3m) from that vertical mass.

Testing Soils: The operation of the ND gauge for testing soils shall be as follows: a. For all test locations, four 30-second measurements (readings) will be taken at 90 degree angles to each other (rotated around the center of the gauge). The density value reported for each test location will be the average of the two measurements taken in either the BS or Direct Transmission mode.

Specifications: In accordance with contract specifications

Report - Results are reported on Form CON-125

5.26 RESISTANCE OF COMPACTED HMA TO MOISTURE-INDUCED DAMAGE

Scope - This method covers preparation of specimens and measurement of the change of diametral tensile strength resulting from the effects of saturation and accelerated water conditioning of compacted HMA mixtures in the laboratory. This test will be performed on HMA Laboratory mixture, mixtures sampled from newly loaded trucks, field pavement samples, and pavement cores.

Sampling - In accordance with AASHTO T 283(M)

Procedure - In accordance with AASHTO T 283(M)

Specification - In accordance with contract specifications

Report - Results are reported with AASHTO T-283(M) Table 1, Moisture Damage Laboratory Data Sheet or form MAT 428 approved by the DRM